MIXING RATIOS OF TRACE GASES IN THE AUSTRAL POLAR ATMOSPHERE DURING AUGUST AND SEPTEMBER OF 1987

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Mixing ratios are presented for a number of long-lived trace gases in the austral polar atmosphere during August and September of 1987. The recent discovery of a 12-year trend of increasing depletion of ozone over the Antarctic Continent in the spring of each year led to numerous theoretical interpretations and several scientific expeditions to the region. The results herein were obtained as part of a major effort involving penetration of the region of depletion by NASA's multi-instrumented aircraft. One of the 14 instruments on the high-altitude ER-2 aircraft collected pressurized air samples between latitudes of 53° and 72° south at pressure altitudes up to 21 km in a series of 12 flights from Punta Arenas, Chile, over the Palmer Peninsula. The sampling system, located in the nose section of the ER-2, has an inlet tube in the free airstream, a metal-bellows air pump, and 14 specially treated 1.6 l stainless-steel canisters for containing the pressurized air at 350 kPa. A programmable controller activated by a switch in the cockpit operated the sampling system according to a schedule selected prior to the flight. A typical flight profile consisted of a southbound path on the 428° K potential temperature surface, a descent to a pressure altitude of 13.7km, a climb to the 460° K surface, and return on this surface. The location of and the time interval between samples was determined by the scientific goals of a flight. Mixing ratios for the trace gases were obtained from gas chromatographic analyses of the pressurized air samples. Additional samples were obtained between latitudes of 42° and 53° south on arrival from Puerto Montt, Chile, on August 15 and on departure to Puerto Montt on September 29. Of the species measured, the mixing ratios for CH_4, CO, N_2O, CF_2Cl_2, $CFCl_3$, CH_3CCl_3, CCl_4, and $C_2F_3Cl_3$ are reported here. Significant changes appear in the mixing ratios along the flight tracks on constant potential temperature surfaces. Changes also occur from flight to flight. Values for samples at the higher altitudes in the southern part of the flights are significantly lower than values from mid latitudes. The variations in mixing ratios of these trace gases indicate the presence, motion, and history of various air masses in the austral polar atmosphere. The influence of the stratospheric polar vortex on the distributions is evident. Relationships between these trace species and the gases and physical parameters measured by others will be discussed.